CHAPTER II :

ANALYSIS OF THE GROWTH OF OUTPUT

I. PROGRESS OF ELECTRICITY UTILITY IN INDIA :

In this section we present an account of the growth of the Electricity Utility Industry in India. The progress of this industry can be looked at from quite a few different angles, by analysing the data given in Table II.1, for instance by considering the growth of installed capacity, power generated, power sold, connected load, number of consumers served, towns and villages covered by electricity, length of transmission and distribution lines etc. Each illuminates a different aspect of the growth of the industry.

II. SOURCES OF DATA :

The present study makes use of the data published in "Public Electricity Supply - All India Statistics - General Reviews"; compiled by the Commercial Directorate; Central Water and Power Commission (Power Wing): on behalf of the

Central Electricity Authority. These data are published by the Government of India; Ministry of Irrigation and Power; Central Electricity Authority. The first publication was in 1951. The above mentioned source gives exhausitve data pertaining to Electricity-Generation by types of plants; sales by Categories of consumers, Installed Plant capacity by types of plants, use of electricity in different industries, electrical accidents etc. Also financial data of public electricity supply undertakings are available for which though the coverage is not complete, it covers more than 90% of the capacity and also kwh sold. For the non-response portion generally in the <u>Public Electricity Supply</u> publication adjustments on the basis of earlier years of response are made. It may be mentioned that <u>Annual Survey of Industries</u> also provide data relating to Electricity. However, such data are not available for all the years under our study and the data are not available in the type of details we want.

The present analysis covers a period of 22 years. Since all the data are not available either for 1950-51 or for 1971-72, some parts of the analysis cover only a period of 21 years.

The output of electricity is looked upon from the point of view of generation; as well as from the point of view of sales to final consumers. In order to capture the qualitative change in output, the study also analyses the weighted output index.

Installed Capacity :

The installed plant capacity at the beginning of the time period of our analysis, i.e. 1950-51, was 1712.5 MW; and at the end, i.e. in 1971-72, it was 15254.4 MW. This reflects almost 9 times increase in installed plant capacity over a period of 22 years. Installed plant capacity gives us an indication about the potential output of electricity.

Power Generated :

Observing the actual output of electricity, measured in terms of million KWH generated, we notice a substantial increase of almost 12 times over the same period of 22 years. This increase in the generation of electricity clearly reflects the progress that this industry has made over a period of 22 years.

Electricity Sold :

Further, the same behaviour of remarkable pace of growth is reflected in the sales of electricity to final consumers. The sales of electricity have increased by 11 times. It may be noted that electricity sold will always be less than electricity generated, on account of transmission and distribution losses, auxiliary consumption and power theft. A word about auxiliary consumption and transmission and distribution losses is in order. Auxiliary consumption formed 3.7% in 1951-52, 4.4% in 1960-61 and 5.1% in 1970-71 of power generated in respective years. The transmission and distribution losses came to 14.8%, 14.7% and 16.7% respectively during 1951-52, 1960-61 and 1970-71.

Connected Load :

Connected load gives us an idea about the maximum amount of electricity that a consumer can consume at a point of time. The total connected load to all the consumers taken together also increased by 9 times, over the same period. Further, the number of consumers served by this utility increased by about 11 times. This indicates that larger and larger number of consumers get the benefits of the progress that this utility has made.

Transmission and Distribution Lines :

It is not enough to produce electricity. But, it is also essential to distribute electricity to the consumers. An idea about the distributive aspect of electricity can be had by looking at the progress made by transmission and distribution lines, measured in terms of circuit kilometers. Transmission and distribution lines registered an increase of 28 times over a period of 21 years, viz., from 1951-52 to 1971-72. This is a tremendous increase indicating that electricity network is now combing the entire length and breadth of the country. In the various Five Year Plans, Electricity is sought to be developed as a basic infrastructure which is available not only to large industries but to small sized units also. The benefits of electricity are no longer confined to the cities and towns, but, as of 1970-71, about 125,000 villages out of 600,000 have been electrified.

Towns and Villages Electrified :

The benefits of the growth of this public utility are not concentrated in few big towns only. This is observed by looking at the number of towns and villages electrified. The number of towns and villages electrified has increased by almost 31 times over a period of 22 years. This shows that, this very important input for the development of industries and agriculture is made available to larger and larger number of towns and villages. It may be noted that rural electrification has picked up only after 1961. Between

Table II.1

Progress of Electricity Utilities: All India - 1950-51 to 1971-72

Year	Installed Generating capacity (MW)	Aggregate Maximum Demand (MW)	Electricity Generated (Gross) (Mil.kwh)	Electricity sold (Mil.kwh)	Auxiliary Consumption (Mil.kwh)	Transmission & Distribution losses (Mil,kwh)
1	2	3	4	5	6	7
1950-51	1712.5	1098.3	5106.7	4156.7	NA	NA
1951-52	1835.4	1205.2	5858.4	4793.3	218.3	864.5
1952-53	2061.8	1310.7	6120.3	5005.7	235.4	962.4
1953-54	2305.2	1416.4	6697.2	5597.1	272.8	913.8
1954-55	2494.0	1625.1	7521.8	6252.5	306.1*	1036.5*
1955-56	2694.8	1849.7	8592.5	7111.0	339.4	1159.3
1956-57	2886.1	1989.8	9662.1	7959.3	386.4	1335.0
1957-58	3223.1	2288.2	11569.1	9430.1	455.5	1523.9
1958-59	3511.6	2542.3	12993.9	10718.6	539.8	1770.6
1959-60	3873.2	2931.4	15033.0	12406.9	600.7	2061.6
1960-61	4653.1	3545.9	16937.0	13840.4	721.9	2485.5
1961-62	5218.8	3971.2	19669.9	16448.3	813.6	2775.4
1962-63	5801.2	4635.0	22365.0	18679.0	912.6	3244.6
1963-64	6575.9	5548.5	26817.6	21794.0	948.0	4026.4
1964-65	7396.7	6257.2	29563.1	24219.3	1303.3	4069.1
1965-66	9027.0	7306.2	32990.1	26734.9	1647.5	4585.2
1966-67	10092.2	8291.6	36375.9	29127.6	1792.6	5510.9
1967-68	11883.2	9702.8	41194.6	32736.9	2075.1	6487.4
1968-69	12957.3	10871.1	47433.7	37352.4	2532.1	7645.1
1969-70	14102.5	11946.2	51988.7	41061.7	2749.3	8279.8
1970-71	14709.0	12532.9	55827.6	42809.2	2863.2	9306.5
1971-72	15254.4	13333.1	60925.6	47063.2	3129.8	10861.8

Table II.1(concluded)

Year	Connected Load (MW)	Consumers served (No.)	Transmission[++] & Distribution Lines (Circuit KM)	Transformer Capacity (MVA)	Towns and villages Electrified (No.)
	8	9	10	11	12
1950-51	2835.1	1500737	N.A.	N.A.	4051
1951-52	3072.8	1677805	39292.7	3736.0	4518
1952-53	3453.3	1843473	44202.7	4108.9	4518
1953-54	3621.2	1995543	52810.4	4837.6	6635**
1954-55	4322.6	2164782	59810.1	5451.4	8751
1955-56	4723.8	2058580	66809.7	6065.1	12554
1956-57	5072.7[+]	2825802	85925.9	7127.0	18299
1957-58	5376.5	3207508	90154.5	8123.7	20499**
1958-59	6155.2	3617849	101861.1	9120.3	22699
1959-60	7020.5	4029740	119935.7	10587.1	23969
1960-61	8225.5	4729163	132473.1	13513.9	29069
1961-62	8602.4	5368431	157888.0	15771.6	36240
1962-63	9410.1	5909900	169510.7	17432.6	41144
1963-64	10798.2	6925750	291324.6	18345.2	44144
1964-65	12605.7	7708879	413138.6	22095.2	47624
1965-66	13603.2	8678051	465679.9	28130.0	54816
1966-67	15673.9	9721951	541704.3	32793.6	56721
1967-68	19336.8	10631914	660859.0	40163.9	63200
1968-69	22060.2	11935624	717615.0	45436.8	75150
1969-70	24438.4	13113254	836301.0	54770.1	92468
1970-71	26230.2	14664978	976059.5	60508.0	106774
1971-72	29418.2	16277909	1117163.0	68178.1	124789

Note :

1. Source: Public Electricity - All India Statistics - General Review, Central Electricity Authority, Ministry of Irrigation and Power, Government of India. Figures are correct upto one decimal point and taken, as far as possible, from each year's publication.

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Note To Appendix Table II.1 (continued)

2. * Simple arithmetic average of 1953-54 and 1955-56 figures.
3. ** Simple arithmetic average of 1952-53 and 1954-55 for 1953-54; 1956-57 and 1958-59 for 1957-58.
4. N.A. = Not Available; MW = Mega Watts = 1000 Kilowatts; kwh = Kilowatt hours, MVA = Megavolt Amperes.
5. Columns 5,6 and 7 will exceed column 4 as utilities generally purchase electricity from non-utilities.
6. ++ The Figures for 1951-52 upto 1956-57 are given in circuit miles and are converted into circuit kilometers by applying the conversion ratio 1 mile = 1.60934 km.

1951-56, per year only 1600 new towns and village were electrified. Between 1956-61, the pace increase to 3500 per annum. During 1961-66 and 1966-71, the number of places electrically connected increased on an average per annum at the rate of 5,000 and 10,000 respectively.

Consumers of Electricity :

All these above discussed indicators of progress of electricity give us an idea about the many sided growth of electricity. An idea about how the quality of the service has undergone a change can be had by looking at the relative share of different categories of consumers in total electricity sold. Classifying the sales of electricity to different categories of consumers, in three groups, on the basis of use of electricity, we have (1) electricity used for lighting purposes; (2) electricity used as a motive power for non-agricultural purposes; and (3) electricity used as a motive power for irrigation in agriculture. The first use of electricity includes Domestic Light and Small Power; Commercial Light and Small Power; and Public Lighting. The second use includes Industrial Power - High and Medium & Low Voltage; Traction and Public Water Works and Sewage

Pumping. The last is the agricultural sector. In the agricultural sector, the use is mostly for purposes of lift irrigation. Electrification of wells is replacing the use of diesel oil engines and traditional bullock lifts. In the plank of rural electrification, electrification of wells is the most important item. The change that took place in the composition of these three uses of electricity can be seen by observing their relative share in total sales of electricity at an interval of 10 years. This information is given below.

Percentage share of different categories of Consumers in Total Electricity Sold :[1]

Category of Consumers	1950-51	1960-61	1970-71
(a) Domestic light & Small Power	12.62	10.70	8.96
(b) Commercial light & small Power	7.43	6.08	6.01
(c) Public Lighting	1.45	1.38	1.17
(d) Industrial Power-L & MV	62.64	11.76	9.14
(e) Industrial Power-HV		57.73	59.95
(f) Traction	7.42	3.25	3.19
(g) Public Water Works & Sewage Pumping	4.55	3.13	0.24
(h) Agriculture	3.89	5.97	10.44

1 Source: Calculated on the basis of Table II.2.

From the above table one observes a persistent trend towards a rulative decline in use of electricity for the purpose of lighting and domestic purposes. Similarly, the relative importance of electricity as a motive power for non-agricultural sector has gone down with the passage of time. This is so because the use of electricity for traction and public water works and sewage pumping has consistently been going down. As against this the use of electricity as a motive power by industries has been going up consistently.

The use of electricity as a motive power by agriculture has a clear and a persistent tendency to increase, with the passage of time.

In summary, we can say that the relative share of electricity for lighting domestic and commercial establishment purposes has gone down from 21.5% in 1950-51 to 16.14% in 1970-71. Similarly, the relative share of electricity used as a motive power in non-agricultural sector has gone down from 74.61% in 1950-51 to 72.28% in 1970-71. As against this, the use of electricity as a motive power in agriculture has gone up from 3.89% in 1950-51 to 10.44% in 1970-71. These figures show the diversification of the uses to which electricity has been put by the consumers. This diversification of uses of electricity reflects changes in the quality of electricity supplied.

Sales Per Consumer and Per KW Connected :

It is also useful to know the change that has taken place in electricity sold per consumer (kwh/consumer) and electricity sold (kwh) per kw of connected load, over a period of time. This information is given in Table II.2. Representing it in the form of a summary, we have :

Category of consumers	Average Sales kwh per consumer			Average Sales kwh per kw connected		
	1950-51	1960-61	1970-71	1950-51	1960-61	1970-71
(a) Domestic light & Small power	453	407	378	715	668	642
(b) Commercial light & Small power	1192	1260	1116	769	1611	1346
(c) Industrial Power-L&MV,HV and Traction Public Water Works & Sewage Pumping	49194	58618	57321	1986	2296	2748
(d) Public lighting	27249	12773	8566	2919	2535	2979
(e) Agriculture	8370	4252	2846	1375	1008	718

given

Looking at the figures given above we notice that the largest consumer is the industrial consumer. Followed by public lighting and then agriculture. The smallest, of course, is the Domestic consumer. The significance of this is that, a given connected load imposes on the installed capacity differing magnitudes of pressure depending on the purpose for which a connection is obtained. Thus, for instance a kw of agricultural connected load was used in 1970-71 for 718 hours as compared to 2747 hours in case of industries. Since electricity cannot be stored and since it must be supplied as and when wanted, an agricultural connection would need a capacity to be created which may not be as well utilised as in case of an industrial connection.

Quinquennial Changes :

Further, observing the behaviour of this industry for a shorter time interval of 5 years, we notice that installed plant capacity upto 1965-66 increased at a faster and faster rate. In between 1965-66 and 1970-71 this rate does not maintain the same speed. The same behaviour is exhibited by electricity sales. The information given below would be of some interest to make certain observations.

Particulars[2]	1950-51	1955-56	1960-61	1965-66	1970-71
1. Installed Plant Capacity(MW)	1712.5	2694.8	4653.1	9027.0	14709.0
Quinquennial percentage change	-	57.4	72.7	94.0	62.9
2. Electricity sold(Mil.kwh)	4156.7	7111.0	12406.9	26734.9	42809.2
Quinquennial percentage change	-	70.1	74.5	115.5	60.1
3. Load Factor	53.1	53.0	51.3	51.5	50.9
4. kwh consumed per kw connected	1466	1505	1682	1921	1632
5. kwh generated per kw of plant capacity	2982	3189	3640	3655	3795
6. kwh sold per KM of Transmission Lines	N.A.	106437	105325	57411	44797

Observing the information given above we notice a continuous fall in the load factor. Load Factor is defined as the "ratio of average load to maximum load in a specified time."* To put it in the notations adopted by UNO, we have

$$L = \frac{U}{t.M}$$

2 Source: Calculated on the basis of Tables II.1 & II.2

* Electricity Costs and Tariffs : A General Study; Department of Economic and Social Affairs, UNO, New York, 1972, p.4.

where L stands for Load Factor, U is the average load represented by kwh generated;M is the Maximum Demand and t is the time; i.e. the number of hours in a year viz., 8760 hours. This is on the assumption that the plant can work for 24 hours in a day. The load factor fails to improve even during 60's, when this industry had shown a remarkably high rate of growth. This can be explained by greater and greater importance given to rural electrification, specially after 1960-61. The agricultural consumer being a relatively smaller consumer fails to improve the load factor. Thus, associated with a very high rate of growth of electricity is the phenomenon of rural electrification. This impact of rural electrification can be further seen by observing the ratio of kwh sold to the KM of transmission lines.

The downward tendency of kwh sold per KM of transmission and distribution lines from 106437 kwh per KM in 1955-56 to 44796 kwh per KM in 1970-71 indicates that a given kwh of power has to be delivered to more and more distant places and consumers, an inevitable consequence of widespread rural electrification.

Appendix Table II.2

Category-wise Classification of Number of Consumers, Connected Load and Electricity Sold - All India Electricity Supply (Public Utilities) - 1950-51 to 1971-72

Category-wise Particulars	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56
1	2	3	4	5	6	7
I. DOMESTIC LIGHT & SMALLER POWER						
(a) Number of consumers	1157016	1307059	1442615	1559906	1744669	1929432
(b) Connected Load (MW)	733.9	859.0	945.7	1003.7	1225.7	1319.3
(c) Electricity Sold (Mil.kwh)	524.6	595.0	628.9	690.5	759.2	850.4
(d) Connected Load per Consumer (kw)	0.6	0.7	0.7	0.6	0.7	0.7
(e) Electricity Sold per Consumer (kwh)	453.4	455.2	435.9	442.7	435.2	440.8
(f) Electricity Sold(kwh)/connected load(kw)	714.9	692.7	665.0	688.0	619.4	644.6
II. COMMERCIAL LIGHT & SMALL POWER						
(a) Number of Consumers	259016	273280	295439	322421	376272	430123
(b) Connected Load (MW)	401.3	327.6	325.6	338.9	365.7	407.6
(c) Electricity Sold (mil.kwh)	308.7	331.5	336.6	399.1	446.2	514.4
(d) Connected Load per Consumer (kw)	1.5	1.2	1.1	1.1	1.0	0.9
(e) Electricity Sold per Consumer (kwh)	1192.0	1213.2	1139.4	1237.9	1185.8	1195.9
(f) Electricity Sold (kwh)/Connected load(kw)	769.4	1012.1	1033.8	1177.8	1220.1	1262.0
III. INDUSTRIAL POWER						
(a) Number of Consumers	63043	70704	74063	78505	83306	99317
(b) Connected Load (MW)	1561.7	1723.1	1995.8	2078.9	2455.4	2632.3
(c) Electricity Sold (mil.kwh)	3101.3	3595.8	3751.0	4211.9	4721.9	5385.7
(d) Connected Load per Consumer (kw)	24.8	24.4	27.0	26.5	29.5	26.5
(e) Electricity Sold per Consumer(kwh)	49193.5	50857.7	50646.6	53651.1	56681.4	54227.4
(f) Electricity Sold(kwh)/connected load(kw)	1985.9	2086.8	1879.4	2026.0	1923.1	2046.0

cont...

Appendix Table II.2(concluded)

Category-wise Particulars	1950-51	1951-52	1952-53	1953-54	1954-55	19555-56
1	2	3	4	5	6	7
IV. PUBLIC LIGHTING						
(a) Number of consumers	2214	2367	2646	2823	2953	3082
(b) Connected Load (MW)	20.7	22.7	24.7	26.5	33.3	36.8
(c) Electricity Sold (Mil.kwh)	60.3	67.9	73.9	81.5	93.9	105.6
(d) Connected Load per consumer (kw)	9.3	9.6	9.3	9.4	11.3	11.9
(e) Electricity Sold Per Consumer (kwh)	27249.3	28694.6	27944.1	28852.3	31798.2	34263.5
(f) Electricity Sold(kwh)/connected loaw(kw)	2918.7	2989.0	2994.4	3072.4	2819.8	2869.6
V. AGRICULTURE						
(a) Number of Consumers	19316	24395	28710	31888	39257	46626
(b) Connected Load (MW)	117.6	140.4	161.4	173.2	242.6	327.8
(c) Electricity Sold (mil.kwh)	161.7	203.0	215.2	214.1	231.4	254.8
(d) Connected Load per consumer (kw)	6.1	5.8	5.6	5.4	6.2	7.0
(e) Electricity Sold Per consumer (kwh)	8370.3	8323.3	7495.4	6715.3	5894.5	5464.8
(f) Electricity Sold (kwh)/connected load(kw)	1375.3	1446.0	1333.4	1236.1	953.8	777.3
VI. TOTAL						
(a) Number of Consumers	1500737	1677805	1843473	1995543	2164782	2508580
(b) Connected Load (MW)	2835.1	3072.8	3453.3	36[illegible]2.2	4322.8	4723.8
(c) Electricity Sold (mil.kwh)	4156.7	4793.3	5005.7	5597.1	6252.5	7111.0
(d) Connected Load per consumer(kw)	1.9	1.8	1.9	1.8	2.0	1.9
(e) Electricity Sold per Consumer(kwh)	2769.7	2856.9	2715.4	2804.8	2888.3	2834.7
(f) Electricity sold(kwh)/connected load(kw)	1466.2	1559.9	1449.6	1545.6	1446.4	1505.4

Appendix Table II.2(concluded)

Category-wise Particulars	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62
	8	9	10	11	12	13
I. DOMESTIC LIGHT & SMALLER POWER						
(a) Number of Consumers	2180659	2474030	2781613	3100327	3666889	4153869
(b) Connected Load (MW)	1414.6	1509.8	1668.9	1863.9	2234.8	2395.9
(c) Electricity Sold (Mil.kwh)	934.1	1094.6	1238.0	1378.5	1492.3	1698.1
(d) Connected Load per consumer (kw)	0.6	0.6	0.6	0.6	0.6	0.6
(e) Electricity sold per consumer (kwh)	428.4	442.4	445.1	444.6	407.0	408.8
(f) Electricity sold(kwh)/connected load(kw)	660.3	725.0	741.8	739.6	667.8	708.8
II. COMMERCIAL LIGHT & SMALL POWER						
(a) Number oc Consumers	469845	515866	588742	634997	672554	770082
(b) Connected Load (MW)	426.0	444.3	494.5	504.8	526.1	599.3
(c) Electricity Sold(Mil.kwh)	545.9	611.5	682.8	766.2	847.7	934.1
(d) Connected Load per consumer (kw)	0.9	0.9	0.8	0.8	0.8	0.8
(e) Electricity sold per consumer (kwh)	1161.9	1185.4	1159.8	1206.6	1260.4	1213.0
(f) Electricity sold(kwh)/connected load(kw)	1281.5	1376.3	1380.8	1517.8	1611.3	1558.7
III. INDUSTRIAL POWER						
(a) Number of Consumers	108756	125414	135860	150789	178692	190149
(b) Connected Load (MW)	2789.5	2946.6	3448.4	3992.6	4561.9	4518.5
(c) Electricity Sold(Mil.kwh)	6045.4	7106.8	8058.2	9330.3	10474.5	12609.5
(d) Connected Load per Consumer(kw)	25.6	23.5	25.4	26.5	25.5	23.8
(e) Electricity sold per consumer (kwh)	55586.8	56666.7	59312.5	61876.5	58617.6	66313.8
(f) Electricity sold (kwh)/connected load(kw)	2167.2	2411.9	2336.8	2336.9	2296.1	2790.6

Appendix Table II.2(concluded)

Category-wise Particulars	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62
	8	9	10	11	12	13
IV. PUBLIC LIGHTING						
(a) Number of Consumers	3694	4549	5296	7382	15126	18088
(b) Connected Load (MW)	41.7	46.5	54.2	57.9	76.2	96.4
(c) Electricity sold (Mil.kwh)	117.8	141.4	156.1	178.0	193.2	215.5
(d) Connected Load per consumer (kw)	11.3	10.2	10.2	7.8	5.0	5.3
(e) Electricity sold per consumer(kwh)	31889.6	31083.8	29475.1	24112.7	12772.7	11914.0
(f) Electricity sold(kwh)/connected load(kw)	2824.9	3040.9	2880.1	3074.3	2535.4	2235.5
V. AGRICULTURE						
(a) Number of Consumers	62848	87649	106117	136245	195902	236243
(b) Connected Load (MW)	401.0	429.2	489.1	601.4	826.5	992.2
(c) Electricity Sold (Mil.kwh)	316.2	565.8	583.5	753.9	832.9	991.1
(d) Connected Load per consumer (kw)	6.4	4.9	4.6	4.4	4.2	4.2
(e) Electricity sold per consumer(kwh)	5031.2	6455.3	5498.6	5533.4	4251.6	4195.3
(f) Electricity sold(kwh)/connected(kw)	788.5	1318.3	1193.0	1253.6	1007.7	998.9
VI. TOTAL						
(a) Number of Consumers	2825802	3207508	3617849	4029740	4729163	5368431
(b) Connected Load (MW)	5072.7	5376.5	6155.2	7020.5	8225.5	8602.4
(c) Electricity sold(Mil.kwh)	7959.3	9430.1	10718.6	12406.9	13840.4	16448.3
(d) Connected Load per consumer (kw)	1.8	1.7	1.7	1.7	1.7	1.6
(e) Electricity sold per consumer(kwh)	2816.7	2940.0	2962.7	3078.8	2926.6	3063.9
(f) Electricity sold(kwh)/connected load(kw)	1569.0	1753.9	1741.4	1767.2	1682.6	1912.1

Table II.2(concluded)

Category-wise Particulars	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68
	14	15	16	17	18	19
I. DOMESTIC LIGHT & SMALL POWER						
(a) Number of Consumers	4466954	5110782	5614414	6379240	7082237	7625274
(b) Connected Load (MW)	2543.5	2795.1	3155.1	3689.4	4310.7	4454.0
(c) Electricity sold (Mil.kwh)	1917.8	2062.4	2246.2	2355.1	2626.7	2928.0
(d) Connected Load per consumer (kw)	0.6	0.5	0.6	0.6	0.6	0.6
(e) Electricity sold per consumer (kwh)	429.3	403.5	400.1	369.2	370.9	384.0
(f) Electricity sold(kwh)/connected load(kw)	754.0	737.9	711.9	638.3	609.3	657.4
II. COMMERCIAL LIGHT & SMALL POWER						
(a) Number of Consumers	957239	1196409	1371534	1408858	1601902	1712237
(b) Connected Load (MW)	807.6	1019.4	1287.1	1022.7	1169.0	1593.6
(c) Electricity sold (Mil.kwh)	1048.6	1179.7	1427.5	1650.1	1819.7	1750.2
(d) Connected Load per consumer(kw)	0.8	0.9	0.9	0.7	0.7	0.9
(e) Electricity sold per consumer(kwh)	1095.4	986.0	1040.8	1171.2	1136.0	1022.2
(f) Electricity sold(kwh)/connected load(kw)	1298.4	1157.2	1109.1	1613.5	1556.6	1098.3
III. INDUSTRIAL POWER						
(a) Number of Consumers	211085	246036	281276	330300	370236	424502
(b) Connected Load (MW)	4904.5	5481.3	6392.9	6749.1	7544.1	9888.2
(c) Electricity sold(Mil.kwh)	14364.2	17154.2	18878.1	20558.3	22266.7	24863.4
(d) Connected Load per consumer(kw)	23.2	22.3	22.7	20.4	20.4	23.3
(e) Electricity sold per consumer(kwh)	68049.4	69722.3	67115.9	62241.3	60141.9	58570.7
(f) Electricity sold(kwh)/connected load(kw)	2928.8	3129.6	2953.0	3046.1	2951.5	2514.5

Table II.2 (concluded)

Category-wise Particulars	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68
	14	15	16	17	18	19
IV. PUBLIC LIGHTING						
(a) Number of Consumers	18323	37316	42397	51181	48509	49102
(b) Connected Load (MW)	67.3	86.6	104.0	104.5	128.8	126.5
(c) Electricity sold (Mil.kwh)	244.9	244.5	270.8	279.6	308.0	349.9
(d) Connected Load per consumer (kw)	3.7	2.3	2.5	2.0	2.7	2.6
(e) Electricity sold per consumer (kwh)	13365.7	6552.1	6387.2	5463.0	6349.3	7126.0
(f) Electricity sold(kwh)/connected load(kw)	3638.9	2823.3	2603.8	2675.6	2391.3	2766.0
V. AGRICULTURE						
(a) Number of Consumers	256287	335207	399258	508572	619067	813438
(b) Connected Load (MW)	1087.2	1415.8	1666.7	2037.4	2501.2	3175.9
(c) Electricity sold (Milkwh)	1103.5	1153.2	1396.7	1891.8	2106.5	2585.3
(d) Connected Load per consumer (kw)	4.2	4.2	4.2	4.0	4.0	3.9
(e) Electricity sold per consumer (kwh)	4305.7	3440.3	3498.2	3719.8	3402.7	3178.2
(f) Electricity sold(kwh)/connected load(kw)	1015.0	814.5	838.0	928.5	842.2	813.1
VI. TOTAL						
(a) Number of Consumers	5909900	6925750	7708879	8678051	9721951	10631914
(b) Connected Load(MW)	9410.1	10798.2	12605.7	13603.2	15673.9	19536.8
(c) Electricity sold(Mil.kwh)	18679.0	21794.0	24219.3	26734.9	29127.6	32736.9
(d) Connected Load per consumer (kw)	1.6	1.6	1.6	1.6	1.6	1.8
(e) Electricity sold per consumer(kwh)	3160.6	3146.8	3141.7	3080.7	2996.1	3079.1
(f) Electricity sold(kwh)/connected load(kw)	1985.0	2018.3	1921.3	1965.3	1858.4	1693.0

Table II.2 (concluded)

Category-wise Particulars	1968-69	1969-70	1970-71	1971-72
	20	21	22	23
I. DOMESTIC LIGHT & SMALL POWER				
(a) Number of consumers	8388113	9128006	10165217	11179392
(b) Connected Load (MW)	4803.1	5042.6	5985.9	6672.0
(c) Electricity sold (Mil.kwh)	3184.2	3491.0	3839.8	4107.5
(d) Connected Load per consumer (kw)	0.6	0.6	0.6	0.6
(e) Electricity sold per consumer (kwh)	379.6	382.4	377.7	367.4
(f) Electricity sold(kwh)/Connected load(kw)	662.9	692.3	641.5	615.6
II. COMMERCIAL LIGHT & SMALL POWER				
(a) Number of Consumers	1930516	2115179	2305727	2542477
(b) Connected Load (MW)	1975.2	2657.8	1911.0	2050.5
(c) Electricity sold(Mil.kwh)	2125.7	2333.3	2572.7	2942.8
(d) Connected Load per consumer (kw)	1.0	1.3	0.8	0.8
(e) Electricity sold per consumer (kwh)	1101.1	1103.1	1115.8	1157.5
(f) Electricity sold(kwh)/connected load(kw)	1076.2	877.9	1346.3	1435.2
III. INDUSTRIAL POWER				
(a) Number of Consumers	470982	509288	557569	595881
(b) Connected Load(MW)	10366.6	10755.7	11631.6	12766.8
(c) Electricity sold(Mil.kwh)	27975.0	30707.0	31960.2	34278.5
(d) Connected Load per consumer (kw)	22.0	21.1	20.9	21.4
(e) Electricity sold per consumer (kwh)	59397.2	60294.0	57320.6	57525.7
(f) Electricity sold(kwh)/connected load(kw)	2698.6	2855.0	2747.7	2685.0

Table II.2(concluded)

Category-wise particulars	1968-69	1969-70	1970-71	1971-72
	20	21	22	23
IV. PUBLIC LIGHTING				
(a) Number of Consumers	52124	53912	58339	64487
(b) Connected Load(MW)	146.3	159.6	167.7	198.9
(c) Electricity sold(Mil.kwh)	372.1	417.7	499.7	490.8
(d) Connected Load per consumer(kw)	2.8	3.0	2.9	3.1
(e) Electricity sold per consumer (kwh)	7138.7	7747.8	8565.5	7610.8
(f) Electricity sold(kwh)/connected load(kw)	2543.4	2617.2	2979.2	2467.6
V. AGRICULTURE				
(a) Number of Consumers	1077902	1338087	1570928	1870019
(b) Connected Load(MW)	4219.6	5359.2	6224.8	7246.2
(c) Electricity sold(Mil.kwh)	3465.3	3714.1	4470.2	5005.6
(d) Connected Load per consumer(kw)	3.9	4.0	4.0	3.9
(e) Electricity sold per consumer(kwh)	3214.9	2775.7	2845.6	2676.8
(f) Electricity sold(kwh)/connected load(kw)	821.2	693.0	718.1	690.8
VI. TOTAL				
(a) Number of Consumers	11935624	13113254	14664978	16277909
(b) Connected Load (MW)	22060.2	24438.4	26230.2	29418.2
(c) Electricity sold(Mil.kwh)	37352.4	41061.7	42809.2	47063.2
(d) Connected Load per consumer (kw)	1.8	1.9	1.8	1.8
(e) Electricity sold per consumer (kwh)	3129.5	3131.3	2919.1	2891.2
(f) Electricity sold(kwh)/connected load(kw)	1693.2	1680.2	1632.1	1599.8

Note: 1. Source: Public Electricity Supply - All India Statistics - Figures are correct upto one decimal point.
2. The category of Industrial Power includes:(a)Industrial Power - L & MV; (b)Industrial Power HV; (c) Traction , and (d) Public water works and sewage pumping.

II. VACUUM EFFECT :

To study the growth of a regulated industry becomes specially difficult because such industries are not allowed to be influenced freely by the market conditions. The public utilities are to be made available to all those who ask for their services, at reasonable prices. In India since 1948, the growth of electricity has occurred in the public sector, whose investment decisions are not necessarily governed by profit considerations.

However, in 1951 only 4051 towns and villages were electrified. Technologically it is an industry where huge investments are needed and which is capable of being put to multipurpose uses. A large unexploited market is awaiting so to say to be exploited. This results in what Dr. Ullmer calls as "The Vacuum Effect". Vacuum effect is defined by Dr.Ulmer as "an advance in production substantially in excess of the long run growth of an industry's potential market."[3] Thus, vacuum effect indicates the initial rush of resources to take advantage of the unexploited market. In the earlier

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3 Ulmer M.J.: Capital in Transportation, Communications and Public Utilities, Princeton University Press, Princeton, p.80.

stages the growth of output of these industries far exceeds the growth of population and income. There are certain stimulating factors that help, in the initial stages, to maintain this tremendous growth of output. Among such factors the important ones are the development of new uses to which the product can be put, a change in consumers' taste in favour of the product, immunity to competition, technological innovations and economies of scale. Electricity, once it emerges is under great pressure to extend its network because of growing demand, because of its being considered an infrastructure, and because an interrelated wide network is technologically more efficient than the small isolated network. In India since 1948, there have been large government allocations to the power sector, as a result of which finance as such has not been a bottleneck.

The "Vacuum Effect" really implies two things - a rush of resources and increase in production at a rate much faster than the rate of increase in population and national income. Secondly, it also implies that there is an acceleration in the rate of growth itself, so that the share of the sector concerned in the national income, increases rapidly.

However, this acceleration cannot be sustained indefinitely and a retardation would set in. That is to say, the rate of growth would start declining.[4]

Accelerating Factors :

The product of a regulated industry like electricity may find new uses partly because of technological advances taking place in the economy. As for example the discovery of newer and better household appliances which are operated with the help of electricity may boost up the demand for electricity substantially, in the earlier stages. Also energy intensive industries may come into existence giving boost to demand for electricity. The demand for electricity may increase further because electricity successfully replaces some of the fuels which were very popular before the electricity became easily available. This is substitution of electricity for other sources of energy, such as coal and oil.

In absence of the availability of fairly close substitutes for the product of a regulated industry, the industry is likely to be immune to competition. The growth of such services may develop unhampered because as the economy

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4 Ibid. Chapter 5, p.77.

develops these services are transformed from luxuries into household necessities.

Since these industries are basically large scale industries they can reap the economies of scale. Due to the economies of scale it is quite likely that the prices of these services may exhibit secular tendency to decline in relation to the general price level. This factor further promotes expansion of these industries at a faster rate in the initial stages. In short, we can attribute Acceleration in demand for electricity to -

(i) Consumer demand:- increase in population and per capita income, urbanization and new uses.

(ii) Demand as motive power : growth of industrial production; growing importance of energy intensive industries; substitution of electricity in place of other fuels and for lift irrigation.

(iii) Economies of scale : Fall in the relative price of electricity.

Retardatory Factors :

As these industries become more and more mature the retarding factors, as against the stimulating factors, become more and more powerful. As a result of this growing importance of retarding influences these industries show a retardation in their growth.

One of the retarding influences is a decline in the income elasticity of demand for the products. As these products become available for mass consumption and cease to be luxuries the income elasticity of demand for them shows a tendency to decline. This is a powerful factor retarding the growth of these industries. This factor assumes a greater importance if it is not possible to find out new uses to which these products can be put.

Another factor that can intensify the retardation is the development of new substitutes for the product. Unless restricted, new industries and new products are likely to compete with these industries and capture the market.

Once retardation sets in an industry it is most likely to persist and intensify. If income elasticity of demand for a product falls, the chances of it rising again are very dim. As a result of this the retardation not only persists but is also intensified further as the industry develops.

As an industry matures, the beneficial effects of technological innovations will become less and less powerful. This happens partly because of the rush of early technological and organizational developments attracted by these industries in the initial stages of their development. Due to this early rush of technological development the scope for having more and more technological advances in these industries becomes smaller and smaller. Over a longer period of time the additional gains from technical advances will tend to disappear. This is so because in the long run as the price of these products declines it may be expected that the price elasticity of demand will ultimately fall.

In brief, the "Vacuum Effect" helps us in understanding the fact that in these industries retardation ultimately sets in. In the initial stages the stimulating influences are more powerful resulting in a substantially higher rate of growth than what the potential market can sustain. As the industry matures the retarding influences become more powerful resulting in a persistent retardation in the growth of these industries. This idea of vacuum effect is applied, in this study, to observe the growth of electricity as a public utility.

High Rate of Growth :

The following figures give a synoptic view of the above discussion in a tabular form :

Annual Rates (compound) of Increases[5]

		1950-51 to 1960-61	1960-61 to 1970-71
1.	Power generated	12.7	12.7
2.	Population	1.9	2.2
3.	Urbanization	2.4	3.3
4.	National Income	3.9	3.5
5.	Agricultural Production	4.1	2.5
6.	Industrial Production	7.4	6.1

The first part of the "Vacuum Effect" tells us about quite a remarkable differential in the rates of growth of regulated industries like electricity and other economic components of growth. In India this differential in the rates is very large, more than three times as compared to the National Income. Not only this, but this differential in the rates has been sustained over a period of 20 years.

5 Source: Basic Statistics Relating to the Indian Economy, Vol.I, October 1974, Commerce Research Bureau, Bombay-400020, Table 5.1.

This high rate of growth of output of electricity can be explained by a number of factors. One of the factors responsible for the continued high rate of growth of electricity is the higher demand exerted by the agricultural sector. In agriculture the demand for electricity rises mainly because of substitution of diesel oil engines by electric motors. This substitution is borne out by the following figures :

Irrigation Pumpsets Operated with :[6]

Year	Oil Engines	Electric Motors
1951	82477	26174
1956	122511	47034
1961	229972	160168
1966	470968	414610
1971	N.A.	1570928

From these figures one can see that the pumpsets operated with oil engines increased by almost 6 times over a period of 16 years. As compared to this, over the same period, the number of pumpsets operated with Electric motors increased by almost 16 times. This indicates the substitution

6 Source : 1951, 1956, 1961, and 1966 data are from Statistical Abstract of India, 1974. 1971 data for electric motors for irrigation are from Table II.2, item Va for 1970-71, in this study.

of oil engines by electric motors. Thus, in agriculture the demand for electricity is mainly on account of this substitution effect.

India, being a developing country, undergoes a structural change with economic development. We observe, from the information given earlier, that the industrial production increases at a faster rate than the national income itself. This higher rate of industrial growth gives a fillup to the demand for electricity, which has already gone up on account of the substitution taking place in agriculture. Earlier, it was pointed out that industrial consumers account for as much as 70% of total electricity sold to final consumers. Thus, a high rate of growth of industries will have a significant influence on the electricity generated and sold.

Over a period of last 20 years the energy-intensive industries have grown at a faster rate. From the point of view of the relative share of different industries in total electricity sold to industrial sector we could identify six major industries, viz., Aluminium, Cement, Chemicals, Cotton textiles, Fertilizers and Iron and Steel. The following information gives some idea about the relative importance of these six industries in the total electricity sold to industrial sector.

Electricity Sold to : (Mil.kwh)

year	All Industries	Six Industries
1950-51	3101	N.A.
1951-52	3596	2440
1955-56	5386	3505
1960-61	10475	5967
1965-66	20558	10360
1970-71	31960	15225

From the information given above, we can see that the electricity sold to these six major industries has increased by six times over a period of 20 years, viz., from 1951-52 to 1970-71. This relatively high rates of growth of some of these six industries becomes apparent when one observes the following information.

Growth Rates of Different Industries[7]

	Between 1951 & 1973 (Per cent)
Fertilizers	21.6
Aluminium	13.3
Iron & Steel Metals	7.2
Cement	7.1
Cotton yarn	2.5
Cotton Fabrics	0.6
Other chemicals & Chemical Products	6.9
All Industries	6.0

Thus, we can say that these six industries taken together have a relatively high rate of growth. This higher rate of growth of these six electricity - intensive industries does account for an increased demand for electricity.

It is interesting to note, from the information given earlier, that the relative share of these six industries in total electricity sold to industrial consumers has been declining over a period of 20 years. It has fallen from

7 Source : Basic Statistics Relating to the Indian Economy, Vol.I, October 1974. Table 8.6, Commerce Research Bureau.

68% in 1951-52 to a mere 48% in 1970-71. This decline in the relative importance of these six industries shows diversification of industries. In other words, we can say that the industries consuming electricity as a motive power have become more diversified with the passage of time. We have further estimated the elasticity of demand for electricity with respect to industrial production. The value of the elasticity of demand for electricity comes to be around 1.8. Thus, we can see that the demand for electricity increases by a larger proportion given an increase in industrial production. The value of elasticity of demand for electricity being greater than one, goes in to show that the substitution of other fuels by electricity is taking place in industries as well. This substitution of other fuels by electricity gives a further boost up to the demand for electricity.

Electricity has been growing in importance as a source of commercial energy; over a period of time. Thus, from the figures given below we can see that electricity replaces coal as a source of commercial energy.

Percentage Share in Total Commercial Energy Consumption[8]

	1953-54	1968-69
Coal	47.8	30.0
Oil Products	39.6	46.5
Electricity	12.6	23.5
Total	100.00	100.00

From figures given above we notice the growing importance of electricity in commercial energy. The relative share of electricity in commercial energy consumed has increased from 13% in 1953-54 to 26% in 1968-69. Electricity seems to be replacing coal as a source of enerrgy. This replacement of coal by electricity further adds to the increasing demand for electricity.

The demand for electricity would get a further boost up if the relative price of electricity has fallen over a period of time. We expect a decline in the relative price of electricity because of the economies of scale resulting in lower cost of production at higher levels of output. The following

8 Ibid. Table 2.8.

figures throw some light on this aspect of the increased demand for electricity.

Price Indices of[9] (1951-52=100.0)

	Coal	Mineral Oil	Electricity
1950-51	100.0	98.4	113.4
1955-56	101.0	104.4	105.9
1960-61	141.0	118.6	125.9
1965-66	176.0	149.3	136.3
1970-71	238.4	188.9	181.0

These figures show that as the time passes electricity turns out to be a cheaper source of energy as compared to coal & oil. Thus upto 1960-61 coal and oil were relatively cheap. From 1960-61 onwards electricity is relatively cheaper as compared to coal. From 1965-66 onwards electricity becomes cheaper as compared to mineral oil also. Thus, a decline in the relative price of electricity is an added factor explaining the increase in demand for electricity.

9 Source: (1) Price indices of coal and mineral oil are from Records & Statistics; Eastern Economist, New Delhi.
(2) Price (inclusive of taxes) index of electricity is estimated by us. These price indices are given in Table II·12 ~~3.8~~, Chapter II of the present study.

Summarising the above discussion we can name five factors which have played an important role in accelerating the demand for electricity in India. These factors are :

1. The substitution of diesel oil engines by electric pumpsets in agriculture.
2. Higher rate of industrial growth.
3. Growth of energy - intensive industries.
4. Diversification of industries.
5. Increasing share of electricity in commercial energy due to a decline in the relative price of electricity.

Acceleration/Retardation in the Rate of Growth :

In the earlier part of the "Vacuum Effect" we had seen that in the initial stages of development, industries like electricity tend to grow at a tremendous rate. In this section we will try to observe the acceleration or retardation in this rate of growth. Thus, the second part of the "Vacuum Effect" tells us that as the industry reaches its maturity there takes place a slackening in the rate of growth of the industry. This happens when the retarding factors become more powerful than the accelerating factors.

The output of electricity can be looked at from two different angles.One way of looking at the output is to look at it as the physical output. Another way of looking at the output is to define it as value added. First, we discuss the physical output of electricity and then go over to the discussion of value added.

Conventionally, the output of electricity is measured in terms of kilo-watt hours generated and sold. Dr. Gould defines kwh in the following words: "The kwh is a unit of electric power equal to about one and one-third horse-power; the kilo-watt hour represents then the generation or use of this power for one hour."[10] The kwh generated is a measure of production of electricity; whereas kwh sold gives an idea about the distributive aspect of the services rendered by public electricity. The output of electricity can be measured in physical terms, viz., kwh sold. At the first sight it would appear that measurement of growth of physical output of electricity is a simple matter because it is expressed in terms of kwh sold. However, a kwh sold to a domestic consumer is not the same thing as kwh sold to an industrial or an agricultural consumer. Ostensibly the

10 Gould J.M.: Output and Productivity in the Electric and Gas Utilities: 1899-1942, N.B.E.R., p.13.

consumption is unit of kwh but the extent of service which goes to different categories of consumers is different. Therefore, some sort of a weighing arrangement of electricity sold to different categories of consumers is needed. One way of incorporating the qualitative differences in the rendering of a unit of electricity to different categories of consumers is to weigh the units sold to different consumers, according to the relative prices charged. Thus if a unit of electricity is sold to residential consumers at 10 paise and to agricultural consumers at 5 paise, the unit sold to residential consumers should be given the weight of 2 and the unit sold to agricultural consumers should be given the weight of 1. The underlying assumption here is that the relative prices réflect the differences in qualities of services rendered to different consumers.

There is, however, the problem that the relative prices (price spread) charged to different categories may be changing. The weights to be attached would then be dependent on the base period we choose. It is necessary to minimize the arbitrariness in the choice of weights.

In order to capture the qualitative variation in distributing electricity and to minimise the effect of the arbitrariness in the choice of fixed price weights, we use the Edgeworth formula[11] given below :

$$\frac{\Sigma\, q_1(p_o + p_1)}{\Sigma\, q_{io}(p_{io}+p_{i1})}$$

where q_1 and q_o represent the number of units in each category of consumers in the current and in the base year, respectively; and p_o and p_1 are corresponding prices paid by each category of consumers, Σ denotes the summation of all the three categories of consumers. With the help of Edgeworth ratio the Weighted Output Index series is estimated. The electricity sold to different categories is given in Table II.2. The prices charged to different categories of consumers are presented in Table II.3, and the Output Index is presented in Table II.4.

11 Gould J.M., op.cit., p.144.

Table II-3

Average Price of Electricity - Category-wise (Paise)

Year	Category of Consumers I	II	III	All Consumers
1	2	3	4	5
1950-51	17.04	4.61	6.80	7.13
1951-52	15.18	4.67	3.30	6.80
1952-53	15.25	4.71	4.37	6.88
1953-54	15.16	4.86	5.98	7.06
1954-55	15.56	4.77	5.32	7.04
1955-56	15.28	4.98	5.57	7.13
1956-57	17.31	4.44	5.22	7.05
1957-58	17.53	5.24	4.95	7.63
1958-59	17.94	5.82	6.10	8.18
1959-60	18.36	5.79	5.76	8.14
1960-61	19.54	6.07	6.26	8.55
1961-62	19.62	5.45	7.06	8.00
1962-63	19.66	5.92	9.41	8.48
1963-64	18.48	6.32	10.93	8.51
1964-65	19.97	5.78	10.12	8.34
1965-66	20.73	6.30	10.49	8.91
1966-67	20.61	7.72	10.89	9.71
1967-68	20.68	8.05	10.80	10.14
1968-69	21.62	8.29	12.12	19.62
1969-70	22.74	8.82	13.93	11.31
1970-71	22.92	9.55	14.12	12.05

Note: We have used the ratio of total revenue derived by Sale of electricity to respective category of consumer to the kwh sold, as the price of electricity. Category of Consumers: I - Domestic Light and Small Power; Commercial Light and Small Power, and Public Lighting; II- Industrial Power-Medium, Low and High voltage, Traction and Public Water Works, and sewage pumping, III- Agriculture.

Table II.4

Weighted Output Index, Unweighted Output Index and Percentage Growth Over Previous Year.

Year	Weighted Output		Unweighted Output	
	Index	Percentage growth over previous year	Index	Percentage growth over previous year
1	2	3	4	5
1950-51	86.40	-	87.17	14.72
1951-52	100.00	15.74	100.00	14.72
1952-53	104.45	4.45	104.47	4.47
1953-54	117.09	12.10	114.32	9.43
1954-55	130.55	11.50	130.50	14.15
1955-56	148.26	13.57	146.67	12.39
1956-57	164.19	10.74	164.93	12.45
1957-58	192.18	17.41	194.07	17.67
1958-59	218.84	13.52	221.81	14.29
1959-60	250.43	14.44	256.61	15.69
1960-61	277.56	10.83	289.11	12.67
1961-62	324.18	16.80	336.28	16.32
1962-63	369.18	13.88	381.77	13.53
1963-64	424.73	15.05	435.25	14.01
1964-65	471.28	10.96	504.64	15.94
1965-66	520.13	10.37	563.14	11.59
1966-67	572.33	10.04	620.93	10.26
1967-68	632.57	10.53	703.19	13.25
1968-69	724.08	14.47	809.69	15.15
1969-70	796.88	10.05	864.59	6.78
1970-71	859.67	7.88	911.71	5.45
1971-72	-	-	1019.70	11.84

It will be seen that the unweighted output increased at an annual rate (compound) of 12.24%, while the weighted output increased at the rate (compound) of 11.96%.

The annual rate of growth, compounded continuously, is estimated by fitting the curve $y = ce^{gx}$; where y denotes output of the industry and x is the time variable. Solving for g, we get the annual rate of growth that is compounded continuously. In other words; both the weighted output;index as well as the unweighted output index increased at almost same percentage rate. Here it may not be out of place to note that the weighted output index may be biased in a downward direction if the quality of the output has undergone an improvement and the weights applied fail to capture this qualitative improvement. Even if we are able to find out an adequate weighting system we may fail to capture all the qualitative improvements. This is so because, as observed by Dr. Gould, "The output index even so will reflect only those quality changes which involve shifts in the relative importance of different classes; quality changes within classes must continue to go unrecorded."[12] Keeping this limitation of the output index in mind, we may make some

12 Gould J.M.: <u>op.cit.</u>, p.43.

observations. From Table II.5, we see that the highest rate of growth in sales of electricity to final consumers is registered by agriculture viz., 17.09%; followed by industries 12.29%; and then by Domestic and Commercial consumers 10.40%. Total electricity generated had a similar rate of growth of 12.36%. As against this the installed plant capacity grew at a slightly lower rate of 10.61%. The highest rate of growth is registered by transmission and distribution lines viz., 17.66%.

A better understanding of the behaviour of the output of electricity utility can be had by observing the quinquennial rates of growth. (Table II.6). For undertaking this analysis we have divided the entire period of 22 years in four sub-periods. The first period almost coincides with our First Five year Plan. Thus it is a period with six years duration from 1950-51 to 1955-56. The second period coincides with the Second Five Year Plan with duration of five years from 1956-57 to 1960-61. Similarly, the third period coincides with the Third Five Year Plan and has a duration of five years from 1961-62 to 1965-66. And the last period again is a period of the remaining six years viz., from 1966-67 to 1971-72. From the Table II.6, we notice that

Table II.5

Annual Average (Compound) Rates of Growth

Particulars	Compound Rate of Growth (Percent)	Form of the Function Fitted is $y = c(e)^{gx}$
1	2	3
I. Sales to/for:		
1. Agriculture	17.09	$y=(119.56)(e)^{0.1709x}$
2.. Domestic, Commercial & Public Lighting	10.40	$y=(796.25)(e)^{0.10399x}$
3. Industrial Power	12.29	$y=(2687.7)(e)^{0.12292x}$
4. Total Sales(i.e. Unweighted Output)	12.24	$y=(3588.40)(e)^{0.12235x}$
5. Weighted Output Index(1950-51 to 1970-71)	11.96	$y=(74.834)(e)^{0.11960x}$
II. Total Installed Plant Capacity	10.61	$y=(13964500)(e)^{0.10609x}$
III. Total Energy Generated	12.36	$y=(4327.1)(e)^{0.12356x}$
IV. Length of Transmission and Distribution Lines 1951-52 to 1971-72)	17.66	$y=(28269)(e)^{0.17662x}$
V. Gross Value Added, at 1970-71 Prices(1950-51 to 1970-71)	13.87	$y=(2894)(e)^{0.13868x}$

Note: Industrial Power includes (i) Industrial Power - Low and Medium Voltage; (ii) Industrial Power - High voltage; (iii) Traction; and (iv) Public Water Works and Sewage Pumping.

Table II.6

Annual Average Rate of Growth, Compounded Continuously for Sales of Electricity to Final Consumers - Category-wise 1950-51 to 1971-72

Period	Annual Average Rate of Growth, Compounded Continuously (Percentages)				
	Agriculture	Industrial Power	Domestic and Commercial Consumers & Public Lighting	Total Sales of Electricity	Total Electricity Generated
1	2	3	4	5	6
First	7.60	11.44	9.74	10.27	9.83
Second	22.24	13.71	11.50	13.81	14.02
Third	15.29	12.51	10.23	12.31	13.10
Fourth	16.68	8.58	8.73	9.60	9.50

Note:

(1) First Period is from 1950-51 to 1955-56 (almost coincident with the 1st Five Year Plan)

Second Period is from 1956-57 to 1960-61 (coinciding with the Second Five Year Plan)

Third Period is from 1961-62 to 1965-66 (coinciding with the Third Five Year Plan)

Fourth Period is from 1966-67 to 1971-72.

(2) Period I and IV have six years and Period II and III have five years.

(3) Industrial Power includes Industrial Power L and MV; Industrial Power HV; Traction, and Public Water Works & Sewage Pumping.

it was the second period during which the total sales as well as generation of electricity registered the highest rate of growth.From the third period and onwards these rates of growth show a declining tendency.Thus, in the case of electricity utility in India the output - total as well as category-wise increases at a growing rate and then this high rate is not maintained as the time passes.

Similar to our experience is the experience of America as observed by Dr. Gould. Putting it in his own words we have, "Thus, the curve traced by a logarithmic parabola fitted to the output index yields an annual rate of increase that declines from 17.8 in 1900 to 14.4 in 1910, to 11.1 in 1920, to 7.9 in 1930 and to 4.7 in 1940. In other words, the fitted trend is subject to retardation at an annual rate of 0.3 per cent."[13]

Let us now see whether we get retardation in the rate of growth of output of electricity in India. In order to know whether retardation has set in in electricity in India or not we have fitted the logarithmic parabola of the form:

$$y = Ka^x \, b^{x^2/2}$$

13 Dr. Gould J.M., <u>op.cit.</u>,p.39.

where y denotes output and x is the time variable. Writing it in the log form we have :

$$\log y = \log k + x \log a + x^2/2 \log b.$$

Solving for b we get the constant log b representing instantaneous rate of change in the rate of change in y. The value of 'b' helps us in estimating the rate of acceleration/retardation in the growth of an industry. The rate of acceleration/retardation is defined as 100(b-1). A value of b greater than one gives us a positive value for this rate indicative of the acceleration in the rate of growth. A value of b which is less than 1 gives us a negative value for this rate of acceleration indicating retardation in the rate of growth of the output.Retardation means that the output, when differentiated with respect to time, increases at a decreasing percentage rate. Similarly, acceleration would mean that the industry has still not reached its maturity and the output increases at an increasing percentage rate.

Observing the results of the fitted curves, given in Table II.7 , we notice that the total sales of electricity show a retardation in the rate of growth. The value of rate of retardation is 0.30 per cent for the unweighted output index. However, weighted output index shows a retardation which is almost half the times, viz., 0.14 per cent, as shown by the sales figures. The only category of consumers to show an acceleration in the sales is the category of agricultural consumers. This is so mainly because of the ambitious plan of the government with respect to rural electrification. As against this the industrial consumers show a high rate of retardation, viz., 0.55%. Industries in India have become more important only after the second Plan. Therefore, it would not be very correct to say that the industrial demand for electricity has reached its maturity and as a consequence the retardation has set in. The slackening in the demand for electricity by the industrial consumer may be the result of stagnation in industrial production from 1965-66. Industrial consumers being the most important category of consumers of electricity, this slackening of the demand for electricity by industries must have affected the total sales of electricity and thus we get the retardation in total sales of electricity.

The generation of electricity also shows a retardation, in the rate of growth, of 0.16 percent. This may be the result of a high rate of growth of electricity generated by hydroplants; which are dependent, in our country, on the rains. The generation of electricity may have further slackened on account of the plants and machinery being not available for production due to repairs. Partly, it may be the result of slackening in the sales itself.

Thus, we face a very peculiar phenomenon where, on the one hand there is large amount of unsatisfied demand for electricity because all the towns and villages are not electrified and industries have to accept staggering; and on the other hand, there is retardation in the rate of growth of output of electricity. Thus, the interpretation of the results becomes very difficult.

On the one hand, there is retardation in the rate of growth of actual output, represented by sales and generation of electricity; and on the other hand there is an acceleration in the rate of growth of potential output, represented by installed plant capacity and length of transmission and distribution lines. Thus, the total installed plant capacity shows an acceleration of 0.81% in the rate of growth. Similarly, transmission and distribution lines show an acceleration of 0.25% in the rate of growth. Thus, a retardation in the actual output and an acceleration in the potential output make it extremely difficult to interprete the results.

Table II.7

Rates of Acceleration/Retardation: 1950-51 to 1971-72

Particulars	Rate of Acceleration/Retardation (Per cent)	Form of the Function fitted is $y = K a^x b^{x^2/2}$
I. Sales to/for :		
1. Agriculture	+0.30	$y=(127.01)(1.4319)^x(1.0030)^{x^2/2}$
2. Domestic, Commercial and Public Lighting	-0.21	$y=(765.43)(1.3005)^x(0.99793)^{x^2/2}$
3. Industrial Power	-0.55	$y=(2403.8)(1.4155)^x(0.99449)^{x^2/2}$
4. Total Sales (i.e. unweighted output)	-0.30	$y=(3364.30)(1.3731)^x(0.99701)^{x^2/2}$
5. Weighted output Index (1950-51 to 1970-71)	-0.14	$y=(72.961)(1.3369)^x(0.99861)^{x^2/2}$
II. Total Installed Plant Capacity	+0.81	$y=(1635700)(1.1649)^x(1.0081)^{x^2/2}$
III. Total Energy Generated	-0.16	$y=(4183.2)(1.3555)^x(0.99838)^{x^2/2}$
IV. Length of Transmission & Distribution Lines (1951-52 to 1971-72)	+0.25	$y=(32562)(1.1559)^x(1.0025)^{x^2/2}$
V. Gross Value Added at 1970-71 Prices (1950-51 to 1970-71)	+0.19	$y=(3024)(1.3446)^x(1.0019)^{x^2/2}$

Note: (1) A positive sign denotes acceleration and a negative sign denotes retardation in the rate of growth.
(2) Industrial Power includes (i) Industrial Power L & MV; (ii) Industrial Power - HV; (iii) Traction, and (iv) Public Water Works and Sewage Pumping.

Timing of Acceleration/Retardation :

A rough idea about the time during which the retardation may have come about can be had by observing annually compounded rates of growth of weighted output index. Looking at the information given in Table II.8. Taking 1951-52 as the base year with an index=100, we have computed 19 possible annual compound rates of growth, considering 1952-53 as a terminal year, 1953-54 as a terminal year and so on until 1970-71 is considered the terminal year. We see that the annually compounded rate of growth, in weighted output index, consistently rises upto 1964-65 and from 1964-65 it shows a downward trend. Thus, we can say that the peak in the rate of growth of the weighted output index must have come around in 1964-65. This is only a rough indicator of the maturity of the industry because, as observed by Dr. Gould, "... it may be shifted by choosing different period for the fitted curve."[14]

Over and above this difficulty, we have the data for only 21 years. On the basis of relatively short time period of only 21 years it would not be advisable to pinpoint a year and identify it as the peak year during which the industry reached its maturity.

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14 Gould J.M., op.cit., p.43.

Table II.8

Annual Compound Rate of Growth in Weighted Output Index
(Base year 1951-52)

Terminal year	Annual Compound Rate of Growth (%)	Terminal year	Annual Compound Rate of Growth (%)
1	2	1	2
1951-52	0	1961-62	12.90
1952-53	4.50	1962-63	12.93
1953-54	6.91	1963-64	13.03
1954-55	9.27	1964-65	13.29
1955-56	10.05	1965-66	13.14
1956-57	10.49	1966-67	12.96
1957-58	11.69	1967-68	12.96
1958-59	12.04	1968-69	13.09
1959-60	12.51	1969-70	12.75
1960-61	12.51	1970-71	12.33

Source : Calculated on the basis of Table II.4.

III GROSS VALUE ADDED

Another measure of the growth other industry is the Gross Value Added. Gross value added is defined as total output produced by electricity minus total inputs consumed by electricity to generate the output. Value added can be measured either by factor cost that is an aggregate of Factor Incomes or by the difference between output and current inputs. In this analysis gross value added is measured by estimating the difference between total production of output and total consumption of current inputs, and then, the electricity duties are added to this difference. The reason why we have preferred the output minus input method over the Factor Income methods is that the data relating to the former were more detailed and secondly, this method enables calculation of output at constant prices easier. The reason behind adding the electricity duties is that all the inputs are valued at purchaser's prices so in order to maintain comparability the output also should be valued at purchaser's prices and not at seller's prices.

This analysis undertakes the study of gross value added. The underlying reason behind this is the feeling that the book value depreciation cannot be taken to represent the fall in efficiency of capital over a period of time. This idea is expressed by Barna when he writes, "Inmost industries which are capital intensive the efficiency of plant tends to increase rather than decrease with life,"[15] Leontief express a similar feeling when he writes that "Recent information indicates that the undepreciated coefficients correspond much more closely to the incremental coefficient than to the depreciated ones."[16] Hashim and Dadi sound a note of aggreement while writing, "It is a fact that a large amount of expenditure is incurred by business firms on repairs and maintenance, whose main object is to keep the asset in a more or less similar productive capacity."[17]

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15 Tibor Barna: "Measuring Capital" in The Theory of Capital, (Eds. F.A.Lutz and D.C.Hague), London, Macmillan,1961, p.85.

16 Harvard Economic Research Project: Estimates of the Capital Stock of American Industries, 1947, Cambridge, Mass.,1953, pp.21-22.

17 Hashim S.R. and Dadi M.M., Capital-Output Relations in Indian Manufacturing, (1946-1964), The M.S.University of Baroda, Baroda, 1973, p.9.

Thus, we could not accept the idea that the fall in the efficiency of capital is by the same amount as represented by the book value depreciation, and therefore, we have not subtracted depreciation from the gross value added. However, for those who might be interested in estimating the net value added we give the book value of depreciation.in Table II.9.

The value of output at current prices is readily available from the Revenue Account of Public electricity published in the "Public Electricity Supply". In other words, the total revenue of electricity from sales to final consumers represents the output of electricity at current prices. The inputs included in estimating gross value added are coal, oil, consumable stores, repairs & Maintenance, purchase of energy & a fraction of general establishment expenses & the Management & administrative expenses.

Gross value added can be measured either at current prices or at constant prices. First, we discuss the gross value added at current prices. As far as the data are concerned, they are readily available from the Public Electricity Supply - All India Statistics. These data give information about the revenue from sales of electricity, to final

Table II.9

Book Value Depreciation of Capital for Electricity Utility

(Rs. in lakhs)

Year	Depreciation	Year	Depreciation
1	2	1	2
1950-51	382	1961-62	1849
1951-52	397	1962-63	2143
1952-53	418	1963-64	2775
1953-54	439	1964-65	2997
1954-55	558	1965-66	3535
1955-56	681	1966-67	4546
1956-57	910	1967-68	5828
1957-58	1069	1968-69	7042
1958-59	1472	1969-70	8252
1959-60	1612	1970-71	9295
1960-61	1696		

Source : Public Electricity Supply - All India Statistics, General Review, Ministry of Irrigation & Power, Central Electricity Authority, Government of India.

consumers and the expenditure on coal, oil, etc. These data are available from the Revenue Account. But Public Electricity Supply - All India Statistics does not publish the data regarding electricity duties. The data pertaining to electricity duties are taken from Statistical Abstract of India, published by the Central Statistical Organisation. The Statistical Abstract of India are published annually, so from number of publications the data are gathered. Inspite of this no data on electricity duties are available for 1952-53, 1953-54, 1954-55, 1956-57, 1957-58, 1958-59 and 1960-61. For these years we had to estimate the electricity duties. We have estimated this by first calculating the percentage of total revenue paid as taxes; and then calculating the change in this percentage of revenue paid as taxes over the required period. From 1951-52 to 1955-56 the percentage of total revenue paid as tax increased by 1.46 per cent point; spreading this increase equally over the three years, we have estimated the electricity duties for the years 1952-53, 1953-54 and 1954-55. In 1951-52, 8.96 per cent of revenue was paid as taxes and in 1955-56 it had increased to 10.42 per cent. Spreading this increase equally over the three years we estimated this percentage to be 9.44 percent for 1952-53, 9.92 per cent for 1953-54 and 10.40 percent for 1954-55. This method gives us the electricity duties to be Rs.376 lakhs, Rs.444 lakhs and Rs.503 lakhs for 1952-53, 1953-54 and 1954-55 respectively.

Electricity duties as percentage of total revenue declined by 1.76 per cent point from 1955-56 to 1960-61. Spreading this decrease equally over the four years, we estimate the electricity duties for 1956-57, 1957-58, 1958-59 and 1959-60. In 1955-56 electricity duties were 10.42 per cent of total revenue and in 1960-61 they were 8.66 per cent of total revenue. Spreading this decline equally over the four years, we have electricity duties as percentages of total revenue to be 9.98 per cent for 1956-57, 9.54 per cent for 1956-57, 9.10 per cent for 1958-59 and 8.66 per cent for 1959-60. This method gives us the electricity duties to be Rs.631 lakhs, Rs.826 lakhs, Rs.971 lakhs and Rs.1068 lakhs for 1956-57, 1957-58, 1958-59 and 1959-60 respectively. Adding these electricity duties to the difference between total revenue from sale of electricity and total input costs, we get the gross value added at current prices.

The publication <u>Public Electricity Supply</u> while it gives figures for expenses on coal, oil, repairs and maintenance and purchase of energy and consumable stores, it does not give data relating to expenses on travels, printing, postage,etc. We had therefore to make an estimate for these items. The Public Electricity Supply give data regarding Management and Administrative Expenses.

We have assumed that 20 per cent of general establishment expenses and Management & Administrative expenses constitute the cost of such inputs at current prices. Major portion of the Management and Administrative expenses is in the form of wages, salaries, director's fees etc. which are factor Incomes. The decision to include only 20 per cent of general establishment expenses and management & administrative expenses is based on the observation of Gujarat Electricity Board data for a period of six years from 1966-67 to 1970-71. From the establishment expenses of the Gujarat Electricity Board we have taken expenses on printing, stationery, postage and telegrams, telephones, repairs & maintenance of office furnitures & buildings, and expenses on transport. From the management & administrative expenses of the GEB we have taken the expenses on travelling only. Having selected the items to be included in inputs from the Gujarat Electricity Board Financial Report, we estimated the percentage of these items to total establishment, Management & Administrative expenses of the GEB. This is done for the above mentioned five years. The percentage of these items to the total establishment expenses and management and administrative expenses comes to be around 19 per cent for all the five years. Rounding off this percentage & assuming it to be the same for all India data also, we have included 20 per cent of general establishment expenses and management & administrative expenses, in estimating the cost of inputs at current prices.

Double Deflation Method

In order to estimate the gross value added at constant prices, we have to deflate the output and inputs expressed at current prices by the appropriate prices. We have deflated the output as well as the several Inputs by appropriate price indices separately. In short, we have used the double deflation method to obtain value Added at constant prices. Gross value added, in this analysis is estimated at 1970-71 prices. Again, the prices of inputs are not available from the "Public Electricity Supply - All India Statistics". Therefore, we had to use different sources for the prices of inputs.

The prices of inputs are taken from Records & Statistics, published by Eastern Economist, New Delhi, of the respective years. The price indexes used for deflating the inputs are that of coal, Mineral Oil, Machinery and equipment & Electricity. All the price indices are expressed by taking 1951-52 as the base year. For some years the prices were to the base of 1961-62 or sometimes 1952-53, but all of them are converted to the 1951-52 base year.

Expenses on coal are expressed at 1970-71 prices by using the price index of coal (1951-52=100). For 1950-51 the price of coal.was not available. But observing the price index remaining 100.00 for 1951-52, 1952-53, 1953-54 and 1954-55 we have assumed it to be 100.00 for 1950-51 also.

In the absence of detailed data on types of oil used and the respective expenditures on them, as well as due to non-availability of data on price index of different types of oil, we have used the price index of mineral oil as a proxy to express expenditure on oil at 1970-71 prices. The price index of mineral oil are available from 1955-56 onwards, no data before 1955-56 are available for mineral oil. These price indexes are with 1952-53 as the base year. First of all we have estimated the price indexes for 1950-51, 1951-52, 1952-53, 1953-54 and 1954-55 with 1952-53 as the base year. The price index of mineral oil increased by 1.1 between 1955-56 and 1956-57. Assuming this increase to be the same we have worked backwards and estimated the price indexes for mineral oil for the years 1950-51, 1951-52, 1953-54 and 1954-55. Having estimated the price indexes for these years, we have changed the base year from 1952-53 to 1951-52. These price indexes of mineral oil are used to express the expenditure on oil at 1970-71 prices.

For expressing the expenditure on consumable stores at 1970-71 prices we have taken simple arithmatic average of price indices of coal and mineral oil.

In order to express the expenditure on repairs and maintenance at 1970-71 prices, we have used the price index of machinery & equipment with 1951-52 as the base year. These price indices are taken from Dr. B.H. Dholakia's book Sources of Economic Growth in India.[18] For the purchases of energy we have applied the price indices of electricity based on electricity prices shown in Table II.3

The best method of estimating the value of general

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18 Dholakia, B.H., Sources of Economic Growth in India, Good Companions, Baroda, 1974.

establishment expenses and management and administrative expenses at 1970-71 prices would be to deflate each and every item included as an input by its own price indices. This somehow could not be done due to non-availability of data. The All India data taken from the "Public Electricity Supply..." do not give any break up of general establishment expenses and Management & Administrative expenses. As a result of this, we could not estimate each and every item separately. Therefore, we have classified all these items under three headings: viz., (i) Expenses on Printing, Stationary, Postage, Telegrams & Telephones; (ii) Expenses on Transport & Travelling; (iii) and Expenses on Repairs & Maintenance. Again, using the data, for the last five years, given by the GEB Annual Report we observed that expenses on printing etc. forms about 24 per cent of establishment, management & administrative expenses that are included in the inputs. Similarly, the relative share of expenses on transport & expenses on repairs and maintenance, in the establishment, management & administrative expenses included in inputs, is 66 per cent and 10 per cent, respectively. Taking these percentages as a good representative of all India situation also, we have segregated the expenses on printing etc., on transport and on repairs and maintenance from the estimated establishment, management & administrative expenses to be included in inputs. Thus, having estimated the expenses on printing, stationary etc., on transport and on repairs & maintenance, we have used three price indexes as deflators; and estimated the value of these three categories of inputs at 1970-71 prices. The price indices used for deflating the expenses on printing, stationery, telephones, telegrams etc. are the wholesale price indices of stationery & paper products with 1951-52 as the base year. These price indices are taken from the unpublished thesis of Shri S. Kishan Rao, entitled Growth, Productivity and Technical Change in Indian Railways: 1951-1972. For deflating the expenses on transport we have used the Passanger Fare indices, 1951-52=100, from above mentioned Kishan Rao's Thesis. The expenses on repairs & maintenance are deflated by the Price Indices of Machinery & equipment taken from Dr. B.H. Dholakia's book Sources of Economic Growth in India.

Thus, we have used three price indices to deflate the estimated expenses on establishment, management & administration.

Table II.10 shows the value of various Inputs and Gross value Added at current prices. Table II.11 shows the same at constant prices (1970-71) and Table II.12 shows the price indices for inputs and output which have been used for obtaining the GVA at constant 1970-71 prices.

For expressing the electricity duties at 1970-71 prices, we have used the price index of electricity, with estimated price of electricity that includes the taxes also. This is done by, first, calculating the excise duties per kwh of electricity sold. In other words, first, we divide total electricity duties by kwh sold. Having, thus, estimated the average tax per unit of kwh sold, we add this to the average estimated price of electricity. Thus, we arrive at the average price of electricity inclusive of taxes. These prices are expressed as price indices with 1951-52 as the base year, and are applied to the electricity duties to express them at 1970-71 prices.

Fitting the two curves, discussed earlier, to the Gross Value Added (GVA) at constant prices, we notice from Table II.5, that the GVA, at constant price, by electricity utility increased at an annual average (compound) rate of

Table II.10

Value of Inputs and Gross Value Added at Current Prices, Electricity Utility :1950-51 to 1970-71

(Rs. in lakhs)

Year	Coal	Oil	Consumable stores	Repairs & Maintenance	Purchase of energy	20% of Est.Admn. & Manage. expenses	Total Value of inputs ~~outputs~~	Total Revenue	Total Revenue less Total value of inputs	Electric duties	Gross Value Added (inclusive of taxes)
1	2	3	4	5	6	7	8	9	10	11	12
1950-51	480	135	-	372	275	63	1325	3393	2068	312	2380
1951-52	542	154	-	365	311	74	1446	3785	2339	339	2678
1952-53	614	161	47	346	289	80	1617	3987	2370	376	2746
1953-54	714	170	44	405	414	79	1826	4477	2651	444	3095
1954-55	746	175	49	427	472	81	1950	4841	2891	503	3394
1955-56	809	194	46	453	632	88	2222	5574	3352	581	3933
1956-57	1092	190	50	560	813	105	2810	6327	3517	631	4148
1957-58	1495	217	78	725	1093	125	3733	8654	4921	826	5747
1958-59	1922	252	76	891	1335	145	4621	10665	6044	971	7015
1959-60	2187	296	88	1030	1497	162	5260	12328	7068	1068	8136
1960-61	2671	351	108	1202	1752	181	6265	14430	8165	1250	9415
1961-62	2958	396	137	1270	2590	265	7616	17062	9446	1490	10936
1962-63	3421	403	115	1448	3697	296	9380	19858	10478	1950	12428
1963-64	3594	472	136	1463	5179	419	11263	23683	12420	2730	15150
1964-65	3991	468	149	1567	6220	573	12968	27832	14864	2940	17804
1965-66	4562	810	250	1884	7553	713	15772	32629	16857	3540	20397
1966-67	5685	378	244	2041	8558	861	17767	38775	21008	4348	25356
1967-68	6512	390	259	2719	8093	993	18966	43243	24277	4891	29168
1968-69	7828	249	246	3085	9451	1169	22028	51308	29280	5481	34761
1969-70	8337	172	241	4325	11264	1174	25513	59304	33791	5820	39611
1970-71	9778	165	309	5442	14005	1284	30983	76404	45421	6720	52141

Sources: (1) Public Electricity Supply - All India Statistics, op.cit., for columns 2,3,4,5,6,8 & 9.
(2) Column 7 as explained in the text.
(3) Column 11, Records and Statistics, Eastern Economist, New Delhi.

Table II.11

Value of Inputs and Gross Value Added at 1970-71 Prices, Electricity, Utility, 1950-51 to 1970-71

(Rs. in lakhs)

Year	Coal*	Oil**	Consumerable stores+	Repairs & Maintenance***	Purchase of energy++	20% of Est.Admn. & Mana. expen.	Total Value of Inputs	Total Revenue	Total Revenue Less Total value of Inputs	Elect. duties	@Gross Value added inclusive of Elec. duties
1	2	3	4	5	6	7	8	9	10	11	12
1950-51	1145	259	-	749	468	92	2713	5775	3062	498	3560
1951-52	1292	291	-	641	551	106	2881	6708	3827	613	4440
1952-53	1464	301	100	566	506	116	3053	6983	3930	670	4600
1953-54	1702	311	93	677	706	122	3611	7642	4031	768	4799
1954-55	1778	320	103	721	808	124	3854	8286	4432	872	5304
1955-56	1909	351	96	761	1061	127	4305	9421	5116	993	6109
1956-57	2244	340	96	926	1389	152	5147	10815	5668	1093	6761
1957-58	2784	360	138	1166	1726	176	6350	13667	7317	1319	8636
1958-59	3445	405	130	1403	1966	202	7551	15711	8160	1452	9612
1959-60	3862	475	149	1585	2216	227	8514	18249	9735	1613	11348
1960-61	4516	559	178	1757	2469	265	9744	20336	10592	1797	12389
1961-62	4966	618	223	1818	3901	352	11878	25699	13821	2273	16094
1962-63	5401	627	180	2009	5254	370	13841	28218	14377	2783	17160
1963-64	5249	629	191	1929	7333	504	15835	33534	17699	3801	21500
1964-65	5624	609	202	2003	8987	688	18113	40213	22100	4184	26284
1965-66	6180	1025	328	2270	10215	815	20833	44129	23296	4703	27999
1966-67	7326	451	304	2250	10621	981	21933	48122	26189	5276	31465
1967-68	7057	442	286	2873	9618	1094	21370	51389	30019	5715	35734
1968-69	7709	272	253	3203	10724	1207	23368	58216	34848	6161	41009
1969-70	8498	182	249	4400	12001	1194	26524	63187	36663	6250	42913
1970-71	9778	165	309	5442	14005	1284	30983	76404	45421	6720	52141

* Price Index of coal, 1951-52 = 100 is applied.

** Price index of Mineral oil 1951-52=100 is applied.

\+ Simple Average of coal and Mineral oil price indices is applied, 1951-52=100.

*** Price indices of Machinery and equipment is applied, 1951-52=100.

continue

13.87%. This rate of growth is very high as compared to other economic indicators like population growth, Gross National Product at constant prices etc. It is interesting to note, further, from Table II.7, that there is an acceleration in the rate of growth of GVA, at constant prices, by the electricity utility; this rate being 0.19%. In short, we make two observations about the GVA by electricity industry. First, the GVA by electricity industry increases at a fairly rapid rate. Second, the GVA by electricity utility increases at an increasing percentage rate.

Note to Table II.11 (continued)

@ Indices of average price of electricity including average tax per kwh sold is applied, 1951-52=100.

Wholesale price indices of stationery and paper products, 1951-52=100, is applied to 24 per cent of this establishment, management and administrative expenses, to evaluate the expenses on printing, stationery, postage, telegrams and telephones at 1970-71 prices. Similarly, passenger fares index, 1951-52=100, is applied to 66 per cent of establishment etc. expenses (i.e. estimated expenses on transport), and Price index of machinery equipment is applied to 10 percent of establishment etc. expenses (i.e. estimated expenses on repairs and maintenance of office furnitures, etc.)

Table II.12

Price Indices Used (1951-52=100.00)

Year	Coal[1]	Machinery & equipment[2]	Passenger Fares Index[3]	Stationary & Paper products[4]	Mineral Oil[1]	Simple Avg. of coal & mineral oil Price Indices	Prices index of electricity (inclusive of taxes)
1	2	3	4	5	6	7	8
1950-51	100.0*	87.2	100.0	100.0	98.4	99.2	113.35
1951-52	100.0	100.0	100.0	100.0	100.0	100.0	100.00
1952-53	100.0	107.3	96.6	100.0	100.8	100.4	101.63
1953-54	100.0	105.1	95.4	81.9	102.0	101.0	104.56
1954-55	100.0	104.0	94.9	84.3	103.2	101.6	104.43
1955-56	101.0	104.5	98.3	98.2	104.4	102.7	105.89
1956-57	116.0	106.2	98.3	97.8	105.6	110.8	104.43
1957-58	128.0	109.2	98.3	109.0	113.8	120.9	113.35
1958-59	133.0	111.5	97.7	115.7	117.5	125.3	121.08
1959-60	135.0	114.1	97.7	113.8	117.9	126.5	119.88
1960-61	141.0	120.0	97.7	108.1	118.6	129.8	125.87
1961-62	142.0	122.6	105.7	108.1	121.0	131.5	118.68
1962-63	151.0	126.5	114.9	110.6	121.5	136.3	126.81
1963-64	162.0	133.1	119.4	112.6	141.8	151.9	130.00
1964-65	169.0	137.3	120.0	110.8	146.3	157.7	127.21
1965-66	176.0	145.7	130.3	106.8	149.3	162.7	136.26
1966-67	185.0	160.6	128.6	106.8	158.5	171.8	149.18
1967-68	220.0	166.1	134.9	106.8	166.9	193.5	154.91
1968-69	242.1	169.0	141.7	120.5	172.8	207.5	161.04
1969-70	233.88**	172.5	140.6	129.5	178.9	206.4	169.56
1970-71	238.42**	175.5	142.9	132.1	188.9	213.7	181.02

* Assumed to be same as in 1951-52. ** The base year is changed from 1961-62 to 1952-53 and then to 1951-52. This is so because all the earlier indices were available with 1952-53 as the base. So all the indices then were changed to 1951-52 as the base year.

1 Price indices of coal and mineral oils are from Records and Statistics, Eastern Economist Publication, New Delhi.

2 Price index of Machinery and equipment are from Dholakia B.H., Sources of Economic Growth in India, Good Companion, Baroda, India, 1974.

3 Price indices of Passenger Fares, and Stationary & Paper Products are from S.Kishan Rao, Growth, Productivity and Technical Change in Indian Railways: 1951-1972, Ph.D.Thesis, The M.S.University, Baroda, 1975.

In summary, we would like to state that there are four indicators of the growth of an industry that we have tried to analyse in this study. One of the indicators of the growth is the unweighted output. We have seen that the un weighted output, measured in physical terms and expressed as million kwh sold, shows signs of retardation in the rate of growth.

The second indicator of growth of electricity industry is the growth of weighted output index. We estimate the weighted output index in order to capture the qualitative differences in output and minimise the influence of the price factor. Like the unweighted output index, the weighted output index also shows a retardation in its rate of growth.

The third economic indicator is the Gross Value Added, at constant prices, by the electricity industry. Here, we notice that there is an acceleration in the rate of growth of GVA, at constant prices, by electricity industry.

The fourth economic indicator that we now discuss is the contribution of electricity industry in the Gross National Product, (GNP). Here, we observe, from Table II.13 that the percentage share of electricity industry in GNP has been increasing with the passage of time. Thus, this share has gone up from 0.25% in 1950-51 to 1.29% in 1970-71. In other words, we observe an increasing degree of importance of this industry in our economy, with economic development

Table II.13

Gross National Product (GNP), Gross Value Added by Electricity Utility (GVA) and Percentage Share of Electricity Utility in Gross National Product

Year	GNP at current prices (Rs. crores)	GVA at current prices (Rs. crores)	Percentage share of electricity in GNP
1	2	3	4
1950-51	9503	24	0.25
1955-56	10342	39	0.38
1960-61	15018	94	0.63
1961-62	15977	109	0.68
1962-63	17099	124	0.73
1963-64	19656	152	0.77
1964-65	23044	178	0.77
1965-66	24112	204	0.85
1966-67	27691	254	0.92
1967-68	32334	292	0.90
1968-69	33403	348	1.04
1969-70	36999	396	1.07
1970-71	40365	521	1.29

Source:

1. Figures of GNP for 1950-51 and 1955-56 are from Basic Statistics Relating to the Indian Economy, Vol.I, Commerce Research Bureau, Bombay-400020, October 1974; Table 5.2.
2. Figures of GNP for 1960-61 and onwards are from National Accounts Statistics, 1960-61 to 1973-74 February 1976, Central Statistical Organisation, Government of India, p.123.
3. GVA by Electricity Utility is from Table No. ~~2.7~~ II.10 of the present chapter.

of our country. Similar is the experience of America in early days of her economic development. This experience is voiced by Dr. Ulmer when he writes, "... in 1896 electric light and power output represented 0.07 per cent of the gross national product. By 19~~06~~50 this percentage had grown to 0.28, despite the fact that the national aggregate had itself expanded substantially."[19]

19 Ulmer M.J., op.cit., p.80.